Sovereign and corporate credit risk: Spillover effects in the Eurozone

Mascia Bedendo*
Università Bocconi

Paolo Colla†
Università Bocconi

Abstract. We provide empirical evidence for the spillover of credit risk from the sovereign to the non-financial corporate segment using credit default swap (CDS) data for Eurozone entities during the recent turmoil in European debt markets. We show that an increase in sovereign risk is associated with an increase in the credit risk (and, hence, borrowing costs) of non-financial firms. We also show that a deterioration in a country's credit quality affects more adversely firms that are government controlled, those whose sales are more concentrated in the domestic market, and those that rely more heavily on bank financing. Our findings suggest that government guarantees, domestic demand, and credit markets are important credit risk transmission mechanisms.

Keywords: sovereign risk, corporate credit risk, credit default swaps, Eurozone.
JEL classification: G01, G15, G32.

* Department of Finance, Università Bocconi, Via G. Röntgen, 20136 Milano, Italy; tel. +39 02.5836.5973; e-mail mascia.bedendo@unibocconi.it.
† Corresponding Author: Department of Finance, Università Bocconi, Via G. Röntgen, 20136 Milano, Italy; tel. +39 02.5836.5346; fax. +39 02.5836.5920; e-mail paolo.colla@unibocconi.it.

1. Introduction

Recent shocks in European debt markets have raised concerns about the steadily growing amount of sovereign credit risk in the aftermath of the 2007–2009 financial crisis. As a result, academics, as well as market participants and regulators, have devoted great efforts to identifying the determinants of sovereign risk, with special emphasis on the decomposition between systemic and country-specific risk (e.g., Caceres, Guzzo, and Segoviano (2010), Dieckmann and Plank (2012), Ang and Longstaff (2013)).

In this paper, we also focus on sovereign risk but shift our attention to whether and how changes in sovereign risk affect the credit risk of the non-financial corporate sector. These issues have important consequences on corporate access to financial markets and, in turn, on borrowing costs. The rationale behind the existence of a spillover from sovereign to corporate credit risk is the so-called transfer risk: A government in financial distress is likely to shift the debt burden onto the corporate sector by increasing corporate taxation, imposing foreign exchange controls, or, in extreme circumstances, by expropriating private investments. Typically, the relation between sovereign and corporate risk has been investigated for emerging markets.[1] Our goal is to gather evidence on this relation for *developed* markets.

To this end, we exploit the recent turmoil in European debt markets, which has led to a sizable increase in sovereign risk for many countries. We assess the sovereign-to-corporate spillover by using credit default swap (CDS) data on 118 non-financial companies headquartered in eight Eurozone countries, together with the corresponding sovereign CDS spreads, between January 2008 and December 2011. In line with recent literature (Longstaff, Mithal, and Neis (2005), Pan and Singleton (2008), Acharya, Drechsler, and Schnabl (2011)), we measure credit risk with CDS spreads, in lieu of bond spreads, since they provide a more direct and timelier measure of the issuer's creditworthiness. The solid line in Figure 1 depicts the evolution of sovereign CDS spreads during 2008–2011 in the Eurozone countries included

[1] Aguiar, Amador and Gopinath (2009) develop a model in which sovereign debt overhang affects investment. Durbin and Ng (2005), Arteta and Hale (2008), and Borensztein, Cowan and Valenzuela (2013) empirically relate sovereign to corporate risk within the context of emerging markets.

in our sample. Sovereign CDS spreads are essentially nil for the first three quarters of 2008 and ramp up after September 2008 –a result of the financial crisis and the consequent bank bailout policies adopted by most governments– reaching levels of 100–200 basis points (bps) at the beginning of 2009. After a tightening during the second half of 2009, sovereign spreads steadily increase again in countries facing fiscal strain (Belgium, Italy, Portugal, and Spain), following concerns about rising government deficits. Sovereign risk rises in the second half of 2011 also in fiscally virtuous economies (Finland, France, Germany, and the Netherlands), although their CDS spreads at the end of 2011 remain much lower (between 50 bps, in Germany, and 150 bps, in France) than those observed in riskier countries (between 250 bps, in Belgium, and 1000 bps, in Portugal). The generalized increase in sovereign risk experienced over the period under investigation questions the plausibility of the common assumption that government debt issued by developed countries is risk free and it is precisely under these circumstances that we want to test if the transfer risk rationale holds true. A preliminary look at corporate credit spreads reinforces our expectations: The dashed line in Figure 1 depicts the time series data on non-financial corporate CDS spreads in the sample, which evidently co-move with sovereign CDS spreads.

Formally, we first show that an increase in sovereign risk is associated with a significant increase in credit risk (and, hence, borrowing costs) of non-financial firms, after controlling for global factors driving both sovereign and corporate credit risk, and idiosyncratic factors affecting corporate CDSs. Moreover, the sovereign-to-corporate spillover turns out to be significant in both peripheral and core economies. Our findings are innovative and not trivial. While a rich empirical literature documents the presence of transfer risk in emerging economies, a significant linkage between sovereign risk and corporate credit risk is not granted *a priori* for developed countries. This is especially true in the context of the Eurozone, where two of the most important channels through which sovereign risk is commonly transferred (i.e., currency controls and the expropriation of private investments) are ruled out.

Second, we take advantage of the cross-sectional variation in firm characteristics to shed light on the mechanisms through which sovereign risk spills over to the corporate sector. Motivated by the existing literature, we investigate three transmission channels:

1. Government guarantees. Concerns about sovereign creditworthiness reduce the value of the debt guarantees enjoyed by firms that are under governmental influence. As a result, those firms should be more sensitive to changes in sovereign risk.

2. Domestic demand. Sovereign crises are frequently accompanied by a reduction in aggregate domestic demand, which affects non-exporting firms more than exporting firms. Consequently, firms whose output is placed primarily on the domestic market should be more sensitive to changes in sovereign risk.

3. Credit squeeze. Sovereign defaults often lead to severe disruptions in domestic credit markets, given that banks typically hold disproportionately large amounts of bonds issued by the domestic government. This, in turn, induces bank deleveraging that negatively affects corporate lending. Hence, firms heavily exposed to bank debt should find it more difficult to renew existing loan financing and, hence, be more sensitive to changes in sovereign risk.

We find evidence supportive of the three mechanisms: A deterioration in a country's credit quality affects more adversely firms that benefit from government guarantees, those with sales more concentrated in the domestic market, and those that rely more on bank financing.

The detection of transfer risk and cross-sectional differences in the underlying transmission mechanisms may have been somehow unexpected in a sample of companies with liquid CDS data. CDSs can only be traded on the debt of companies that issue rated, publicly traded bonds, which act as reference assets in the CDS contract. These companies are typically larger, more internationally oriented, less financially constrained, and less dependent on bank lending than other firms.[2] As a result, we believe that our findings may underestimate the

[2] Ashcraft and Santos (2009) find that the introduction of CDSs leads to an improvement in borrowing terms for safe and transparent firms. Saretto and Tookes (2013) find that firms with CDS contracts on their debt are characterized by higher leverage ratios and longer debt maturities. Additionally, the impact of CDSs on leverage and maturity is greatest in periods in which credit supply constraints are

impact of an increase in sovereign default risk on corporate borrowing costs for the average firm.

Our paper contributes to the recent and fast-growing literature on the relation between sovereign and corporate credit risk in developed economies, which has, so far, mainly focused on financial firms. Acharya, Drechsler, and Schnabl (2011) and Ejsing and Lemke (2011) provide empirical evidence on the effect of bank bailouts on sovereign credit risk and, more generally, on the relation between sovereign risk and bank credit risk during 2007–2010. The literature on sovereign-to-corporate credit risk spillover for non-financial firms in developed countries is, instead, very scarce. The paper most closely related to ours is that of Bai and Wei (2012), who document that a widening in sovereign CDS spreads affects corporate CDS spreads from January 2008 to February 2010.[3] Our analysis differs in several aspects. First, we concentrate on the credit risk transmission to non-financial firms in developed economies, while they do not distinguish between 1) banks and other firms or 2) developed and emerging markets. We expect transfer risk to be stronger for financial institutions and within emerging economies, given that 1) banks are more directly and heavily exposed through their holdings of sovereign bonds (Kallestrup, Lando, and Murgoci (2012)) and 2) emerging countries have traditionally adopted more measures to transfer sovereign risk. Second, we differ in the proposed channels of transmission: We focus on the cross-sectional variation in firm-specific variables such as government control and exposure to the domestic market and to the

most binding. Oehmke and Zawadowski (2013) report that large firms with more debt outstanding (mainly in the form of bonds) are more likely to become reference entities in the CDS market.

[3] Related studies by Andrade and Chhaochharia (2012) and Augustin et al. (2012) extend the analysis of the spillover mechanism to non-financial firms. Andrade and Chhaochharia (2012) document a significant association between increases in sovereign credit spreads and decreases in the analysts' earnings forecasts of both financial and non-financial firms in the Eurozone. Through a comparison of the cost of debt for governments and firms, we complement their analysis, directly assessing the impact of an increase in sovereign spreads on the borrowing costs of non-financial firms. Augustin et al. (2012) also study the effect of an increase in sovereign CDS spreads on corporate CDS spreads but limit their analysis to the impact of the Greek sovereign credit risk shock on European firms from March 2010 to June 2010.

banking sector, while Bai and Wei (2012) explore the role of property rights institutions in determining the cross-country variation in the intensity of the spillover.[4]

The paper is organized as follows. Section 2 illustrates the steps we undertake to construct the data set used in the analysis. Section 3 contains a preliminary analysis of the common factors driving sovereign and corporate CDS spreads. Section 4 presents the empirical findings on the credit risk spillover from the sovereign to the corporate segment. Section 5 investigates the transmission mechanisms, while Section 6 provides some robustness tests for our findings. Section 7 concludes the paper.

2. Sample construction and summary statistics

We use CDS spreads as a measure of credit risk. A CDS contract essentially represents an insurance contract against the risk that an entity (sovereign or firm) will default on its debt. The key advantage to using CDS spreads instead of bonds spreads is that they provide a more accurate measure of the issuer's credit risk (Longstaff, Mithal, and Neis (2005), Pan and Singleton (2008), Longstaff et al. (2011)), given that bond spreads are driven by a multitude of other factors, among which liquidity premia play a prominent role. While illiquidity is unlikely to be a concern for sovereign bonds, which are actively traded on the secondary market, it is a significant component of non-financial corporate bond spreads. Both the sovereign and corporate segments of the CDS market enjoy, instead, comparable liquidity.

We obtain CDS spreads on sovereign and non-financial entities from the MarkIt Group, a standard provider of CDS data, largely employed by academics and practitioners.[5] To ensure

[4] The developed economies in our sample enjoy very similar property rights. According to Bai and Wei's (2012) classification scheme, their quality of property rights institutions is either "good" or "mixed." Therefore, investigating the role of property rights for Eurozone countries is redundant, since they do not display enough variation.

[5] MarkIt provides composite prices based on quotes contributed by more than 30 major market participants on a daily basis. The quotes are filtered to remove outliers and stale observations and a daily composite spread is computed only if two or more contributors report a valid quote. See Mayordomo, Peña, and Schwartz (2013) for a list of papers that use MarkIt data.

liquidity, we consider only the five-year maturity, which is the reference expiry in the corporate CDS segment. We select euro-denominated CDS quotes for senior unsecured debt with the modified-modified restructuring clause for firms and the cumulative restructuring clause for sovereigns, which represent the conventional (and, hence, most liquid) terms for CDS contracts on European reference entities. We restrict the analysis to euro-denominated CDS contracts, since the euro is the standard reference currency for most CDSs on European corporate reference entities. For consistency, we also use euro-denominated CDSs on sovereigns, even though the most liquid contracts in this market segment are in U.S. dollars. This is unlikely to introduce a bias, given that the correlation between weekly changes in euro CDS spreads and weekly changes in U.S. dollar CDS spreads on the sovereign entities in the sample is equal to 94.4%. We restrict the sample to members of the euro area that adopted the euro by 2001, given the scarcity of firms located in the new Member States (Cyprus, Estonia, Malta, Slovakia, and Slovenia) with CDSs traded on their debt. We do not consider Luxembourg because its sovereign CDS is not available from MarkIt. Finally, we exclude the Eurozone subsidiaries of companies headquartered elsewhere. At this stage we have CDS data on 240 companies and 11 sovereigns.

Our data set includes daily CDS premia (in bps) between January 2008 and December 2011. We carry out the analyses at the weekly level and derive weekly CDS spreads as simple averages of the daily spreads in the week, which enables us to reduce measurement errors that may contaminate daily spreads. We limit the sample to firms that have publicly traded equity in order to compute a set of market-determined control variables at the firm-level (as detailed in Section 4).

To avoid bias due to missing or stale data, we apply a number of filters, in line with the existing literature (Berndt and Obreja (2010), Schneider, Sögner, and Veza (2010)). First, we exclude CDS series where 1) the percentage of missing spreads exceeds 15% of the overall period –that is, more than 31 missing weekly spreads– and 2) the length of the longest series of consecutive missing spreads is more than two weeks. Second, we exclude stale observations

with zero changes in corporate or sovereign CDS premia. Finally, we require valid data on a minimum of four companies per country and thus remove countries with infrequent CDS transactions. Following such restrictions, Austria, Greece, and Ireland are excluded because they do not have sufficient numbers of companies that meet our data quality thresholds. The final sample includes 118 companies headquartered in eight countries.

Table 1 reports the sample breakdown by country. France and Germany are the most represented countries, each one comprising about 25%-30% of the sample, in line with the composition of widely traded CDS indexes, such as the iTraxx Europe index for non-financial firms.[6] According to the summary statistics of sovereign CDS spreads, countries can be split into two groups. The first is formed by countries characterized by a relatively low level of credit risk (Finland, France, Germany, and the Netherlands): Sovereign CDS spreads are, on average, about 50 bps or less and fairly stable. The countries in the second group (Belgium, Italy, Portugal, and Spain) are riskier, as confirmed by average sovereign CDS spreads close to 100 bps or higher and much greater variation than observed for countries in the first group. Corporate CDSs reflect medium credit quality, with median values (computed at country-level) of firm ratings ranging from BBB for Finland and Portugal to A- for Belgium, the Netherlands, and Spain. A number of reference entities (21 out of 118) are assigned a sub-investment grade rating at some point during the sample period. These firms are unevenly distributed across countries, as they represent 10% of the corporate sample in Spain, 18% in Italy, 21% in France, 23% in Germany, and 38% in Finland.

[6] The composition of the on-the-run iTraxx Europe indexes can be found at: http://www.markit.com/en/products/data/indices/credit-and-loan-indices/index-annexes/annexes.page.

3. Commonalities in sovereign and corporate credit spreads

Before investigating the impact of changes in sovereign risk on corporate CDS spreads, we explore the extent to which such changes are driven by common factors. This will help us gain insights on the choice of control variables.

We first look at the correlation matrices of weekly changes in sovereign and corporate CDS spreads, respectively. In line with Longstaff et al. (2011), we find large co-movements in sovereign spreads, with an average pairwise correlation of about 63% over the sample period. Instead, the corresponding average pairwise correlation in weekly spread changes of the non-financial firms in the sample is only about 43%. These figures suggest that sovereign CDS spreads are more influenced by global factors than are corporate CDS spreads, where idiosyncratic variables are then expected to play a more prominent role.

To better understand the sources of commonality in sovereign and in corporate spreads, we conduct a principal component analysis (PCA) of the changes in sovereign CDS spreads and compare the results with those for the PCA of the changes in corporate CDS spreads. The PCAs are performed on the correlation matrices of weekly spread changes. The results are presented in Table 2 and essentially confirm the preliminary intuition provided by the correlation analysis. The findings on sovereign spread changes are in line with those from previous studies (Longstaff et al. (2011), Dieckmann and Plank (2012)) and indicate a large degree of commonality in the dynamics of sovereign CDS spreads in the euro area. Panel A shows that the first principal component (PC) explains 69% of sample variation, whereas the first five components explain 95%. When looking at the PCA on corporate spread changes, we observe instead a much lower degree of commonality in CDS spread changes for non-financial firms in the Eurozone. The first PC explains about 47% of sample variation, and the first five components explain a little more than 60%. As for the economic interpretation of the main factors, Panel B reveals that the first PCs turn out to be highly correlated with log returns of the EuroStoxx 50 index and changes in the VStoxx implied volatility index, as well as a number of additional common factors that we use in the multivariate analysis (see Table

A1 in the Appendix for a detailed description of these factors). Further, the correlation between the time series of the first PC extracted from sovereign and corporate CDS changes is equal to 52.21%. These findings confirm that the main source of variation across both sovereign and corporate spreads is significantly linked to general Eurozone market factors.

Figure 2 plots the loadings of the first PC for the eight sovereigns, as well as a histogram of the loadings of the first PC for the firms in the sample. The weighting of the common component is essentially the same (about 0.35) for all sovereigns except Portugal, which suffered repeated credit downgrades over the period under investigation. The factor loadings of the first component are instead much smaller and more heterogeneous for the non-financial firms in the sample, as highlighted by the histogram, which shows a relevant dispersion around the median weighting of 0.10.

Our findings suggest that, while general market indicators common to the euro area seem to have a strong and uniform impact on the dynamics of sovereign credit spreads, their effect on corporate spread changes is much more limited and mixed, and other variables (local and firm-specific) should be accounted for when attempting to explain such changes.

4. Relation between sovereign and corporate credit risk

As a preliminary step towards understanding the link between sovereign and corporate credit risk, we plot in Figure 3 the rolling correlation, computed over 52 weeks, between median changes in log weekly corporate CDS spreads and changes in log weekly sovereign CDSs for the countries in the sample, together with 90% confidence intervals. The plots document a fairly high correlation, with average values, computed over the entire sample period, ranging from 36% in Belgium to 64% in Italy.

To formally investigate the effect of variations in sovereign risk on corporate credit risk we regress changes in log weekly corporate CDS spreads on changes in log weekly sovereign CDS

spreads.[7] We use log CDS spreads to reduce the effect of outliers and enhance comparability across sovereigns, firms and time periods with dissimilar CDS levels.

The commonalities in the dynamics of corporate and sovereign CDS spreads, highlighted in Figure 1 and in the PCA, suggest the existence of general market factors that account for an important share of the variation in credit risk within the Eurozone. Hence, to isolate the impact of changes in sovereign creditworthiness due to country-specific factors, we need to control for a number of global Eurozone variables. Additionally, as discussed in Section 3, firm-specific factors are likely to play a significant role in explaining changes in corporate CDS spreads and, as such, must be included among our determinants. Consequently, we enrich our specification with a set of global and idiosyncratic variables. To keep the model parsimonious, we retain a limited number of explanatory variables suggested by the existing literature on the determinants of corporate credit spreads (Collin-Dufresne, Goldstein, and Martin (2001), and Campbell and Taksler (2003)) and sovereign credit spreads (Longstaff et al. (2011), Dieckmann and Plank (2012), and Ang and Longstaff (2013)). Table A1 in the Appendix details the construction of the selected variables.

Global factors. We consider a number of variables representative of equity, fixed income and currency markets in the Eurozone. Improvements in the general business climate decrease default probabilities and increase recovery rates, thus implying a negative relation with credit spreads. We use the EuroStoxx 50 index log returns as a proxy for variations in the business climate. We also employ changes in market-wide volatility as a further proxy for the business climate, as well as an indicator of investors' risk aversion (Pan and Singleton (2008)): An increase in aggregate equity volatility is associated with higher uncertainty about future economic prospects, and translates into an increase in credit spreads. We measure

[7] The choice of using changes in CDS spreads –instead of CDS levels– is motivated by our focus on the impact of variations in sovereign credit risk on variations in corporate credit risk. Additionally, CDS spreads are non-stationary, over the period under investigation, for most firms in the sample. According to Dickey-Fuller tests with time trend and intercept, the null hypothesis of unit root in CDS levels is rejected only for 13 firms out of 118 at the 5% significance level, while changes in CDS spreads are always stationary. Results are available from the authors upon request.

variations in market-wide volatility with changes in the VStoxx index, i.e. the implied volatility index of the EuroStoxx 50 index. The third global factor we borrow from the equity market is the equity risk-premium, which is expected to exhibit a positive relation with credit spreads. We proxy changes in the equity risk-premium with changes in the EuroStoxx 50 price-to-earnings ratio. We include three control variables from fixed income markets: Changes in spot rates, changes in the slope of the yield curve, and changes in the Euro investment-grade corporate bond spread. Higher spot rates increase the risk-neutral drift of the firm value process, and thus reduce the risk-neutral probability of default and credit spreads (Longstaff and Schwartz (1995)). We use changes in the 5-year Eurozone AAA government bond yields to measure variations in spot rates. The slope of the yield curve contains useful predictive content for future short rates and economic activity (Estrella and Hardouvelis (1991)), and we expect a negative relation between changes in corporate credit risk and changes in the slope of the term structure. Variations in the slope of the yield curve are obtained as changes in the difference between the 10- and 2-year Eurozone AAA government bonds yields. We include changes in the spread of Euro investment-grade corporate bonds (measured as the difference between the FTSE Euro Corporate BBB and AA yields) to capture the range of variation in investment-grade bond yields and, hence, general changes in credit risk in the Eurozone. Finally, we account for variations in the state of the currency market by using changes in the Euro/USD exchange rate.

Idiosyncratic factors. Firm-specific equity return and risk are expected to affect a firm's probability of default, and hence corporate CDS spreads, over and above what can be ascribed to more general movements in equity market returns and volatility. We use firm excess returns, relative to the domestic Dow Jones Total Market index, as a measure of idiosyncratic equity returns,[8] and proxy variations in idiosyncratic volatility with changes in the standard deviation of firm excess returns.

[8] Equity returns have also been used in studies of yield changes to proxy for changes in (market) leverage, given that variations in book leverage are only available at very low frequency.

Given the choice of control variables, we estimate the following OLS regression:

$$\Delta\log(\text{CDS}_{ijt}) = \alpha_i + \beta\Delta\log(\text{Sov CDS}_{jt}) + \gamma\Delta X_{it} + \varepsilon_{ijt} \quad (1)$$

where $\Delta\log(\text{CDS}_{ijt})$ is the change in the log CDS spread in bps of firm *i* headquartered in country *j* from week *t*-1 to week *t*, $\Delta\log(\text{Sov CDS}_{jt})$ is the change in the log CDS spread in bps of country *j* from week *t*-1 to week *t*, ΔX_{it} are the changes from week *t*-1 to week *t* in the global and idiosyncratic factors, and α_i are firm fixed effects.

Column 1 of Table 3 presents the regression results and documents a highly significant sovereign-to-corporate spillover effect. The estimate for β indicates that a 10% increase in sovereign credit risk produces a 1.74% increase in corporate credit risk. As for the control variables, we find that most global and idiosyncratic factors are significant, and the signs of the coefficients square well with economic intuition: Corporate credit spreads widen following an increase in volatility (both aggregate and idiosyncratic) and in aggregate corporate credit risk, or an exchange rate depreciation. Changes in corporate CDS spreads are instead negatively associated with variations in spot rates and with improvements in a firm's financial health and, more general, in business climate conditions.

To account for cross-firm variation in the sensitivity of corporate credit risk to common market factors (as suggested by the PCA findings in Section 3) as well as to idiosyncratic factors, we opt for a more flexible specification than (1) and allow the coefficients on the global and idiosyncratic controls to be firm-specific:

$$\Delta\log(\text{CDS}_{ijt}) = \alpha_i + \beta\Delta\log(\text{Sov CDS}_{jt}) + \gamma_i\Delta X_{it} + \varepsilon_{ijt} \quad (2)$$

The coefficient of interest is still β, which encapsulates the transmission of credit risk from sovereign entities to non-financial firms. Column 2 of Table 3 presents the regression results and shows that the estimate of β remains stable when we accommodate firm-specific coefficients of the control variables. The (adjusted) R-squared increases from 29% to 33%, hence we select specification (2) as the baseline for the following analyses.

Finally, we relax the assumption of a common β, and account for firm-specific sovereign-to-corporate spillover effects by re-estimating model (1) using firm-by-firm regressions. This approach grants maximum flexibility to our specification, allowing for a heterogeneous response of firms' creditworthiness to changes in sovereign risk as well as in the control variables. Figure 4 plots the β_i coefficients together with their 90% confidence intervals for the firms in the sample: The estimated coefficients are mostly positive, and indeed show an important cross-section variation, with values ranging between -0.085 and 0.5. Column 3 in Table 3 reports average regression coefficients together with their estimated standard errors[9] (in parentheses), and confirms a positive and significant association between changes in sovereign and corporate credit risk.

5. Channels of transmission

Our findings document a significant (both economically and statistically) transmission of credit risk from sovereign to corporate entities. Furthermore the evidence in Figure 4 suggests considerable heterogeneity in the sovereign-to-corporate spillover. We now identify the firm-specific transmission channels behind such heterogeneity.

5.1. Government guarantees

Government-controlled firms enjoy both deep credit lines and debt guarantees from the state. Faccio, Masulis, and McConnell (2006) study 450 firms from 35 countries and document that politically connected firms are more likely to be bailed out than similar unconnected firms. Borisova and Megginson (2011) find that, as a result of privatization, a 1% decrease in government ownership is associated with a 0.75 bps increase in a firm's credit

[9] Throughout this article, standard errors for average coefficients of firm-by-firm regressions are computed as in Collin-Dufresne, Goldstein, and Martin (2001). Given a sample of N firms, we calculate standard errors scaling the cross-sectional standard deviation of the N estimates for each coefficient by the square root of N. Firm-by-firm regressions are estimated for corporate reference entities that have at least 12 observations.

spread. However, when concerns about the solvency of the government arise, government guarantees quickly lose value, thus eroding the creditworthiness of government-controlled companies. In addition, these firms are usually more likely to be the target of *ad hoc* measures should the government need to quickly raise funds in the face of budget concerns. As a result, we expect firms under governmental influence to be relatively more affected by an increase in sovereign credit risk.

An obvious candidate for the identification of government-controlled firms would be the proportion of equity owned by the government, either directly or indirectly. However, this measure does not provide a realistic representation of the influence exercised by the government on a firm: By examining a sample of firms that underwent privatization, Bortolotti and Faccio (2009) document that governments tend to retain substantial power in formerly state-owned enterprises in a number of ways.[10] Privatizations of state-owned firms often witness the sale of equity without a proportional transfer of control. Consequently, government ownership is likely to underestimate the actual involvement of governments in firms. We therefore resort to the FEEM–KPMG Privatization Barometer (PB)[11] database to identify firms that have been entirely or partially privatized by the state and which may still be *de facto* under the government's influence through one of the mechanisms discussed above. We create the (firm–year) indicator variable *Govt,* which, for firm *i* and year *t,* equals one if firm *i* is listed in the PB in any year between 1977 and *t*-1, and zero otherwise. We then use national stock exchanges' and regulatory bodies' websites (see the data appendix in Bortolotti and Faccio (2009) for a list of data sources) to augment the indicator *Govt* for

[10] For instance, a government can adopt ownership-leveraging devices (pyramiding and dual-class shares) and remain the largest ultimate shareholder of a firm even without owning a majority of its equity. Alternatively, governments can hold golden shares, which enable them to outvote all other shareholders and significantly affect corporate decisions. Over the past decade, the European Court of Justice has in several instances declared the holding of golden shares by France, Germany, the Netherlands, Italy, Portugal and Spain illegal.

[11] The PB is a monthly updated database containing privatization transactions for 25 European countries from 1977 to the present. The database provides information on the percentage of direct retained government ownership and the dates of privatization transactions and was used by, among others, Borisova and Megginson (2011).

those cases where a firm is state controlled but has never been privatized (and, hence, is not included in the PB database). The median value of *Govt* in the sample equals zero.

To empirically assess the relevance of the government guarantees channel, we add to the right-hand side of specification (2) the direct effect of the government control dummy (*Govt*) and its interaction with $\Delta\log(\text{CDS}_{jt})$:

$$\Delta\log(\text{CDS}_{ijt}) = \alpha_i + \beta\Delta\log(\text{Sov CDS}_{jt}) + \gamma_i\Delta X_{it} + \eta\, Govt_{it} + \theta\Delta\log(\text{Sov CDS}_{jt})\ Govt_{it} + \varepsilon_{ijt} \quad (3)$$

where β and $\beta+\theta$ capture the sovereign-to-corporate credit risk transmission for non-government controlled and government controlled firms, respectively. We complement this analysis using firm-by-firm regressions, by averaging coefficient estimates from the individual regressions separately for firms without government guarantees (*Govt*=0) and with government guarantees (*Govt*=1). We then test for significant differences in those average parameter estimates.[12]

Table 4 reports the results from the pooled OLS regression in Column (1) and the firm-by-firm analysis in Columns (2)-(4). Consistently with our conjecture, we observe a significantly stronger sovereign-to-corporate credit risk transfer for firms under government influence. Following an increase in sovereign risk, government-controlled firms experience an increase in CDS spreads which is, on average, 40% higher than other firms.

5.2. Domestic demand

Following an increase in sovereign risk, governments may decide to adopt restrictive monetary or fiscal measures aimed at restoring creditworthiness, which can lead to a significant contraction in domestic demand. This, in turn, can increase default risk for those

[12] We are mostly interested in studying the role of several firm attributes (government guarantees, sales concentration in the domestic market, and reliance on bank debt) in mitigating or worsening the impact of sovereign risk on corporate credit risk. However, any inference may be confounded if variation in these firm attributes is endogenous to unobserved variation in corporate CDS changes. To address this concern, we have replicated our analyses using only firm characteristics measured at the beginning of our sample period, i.e. December 2007. Results are qualitatively unchanged, and available from the authors upon request.

firms whose businesses rely heavily on the domestic market: Non-exporting firms are more likely to experience a decline in profits and net worth and, thus, to face tighter borrowing constraints (Arteta and Hale (2008)). Consistently with this channel, Borensztein, Cowan, and Valenzuela (2013) document a larger impact of sovereign credit ratings on corporate credit ratings for firms in the non-tradable sector relative to those in the tradable sector.

We retrieve information from the Bureau Van Dijk's Orbis database on geographic segmentation of sales and use the proportion of domestic sales (*Sales*), computed as the ratio of sales in the country where the company is headquartered to total sales, as a measure of exposure to the domestic market. Orbis variables are available at annual frequency and we match CDS quotes in a given year t with *Sales* computed at year-end t-1. Overall, we have information on *Sales* for about 75% of the sample firms.

Similarly to what we have done for the government guarantees channel,[13] we first estimate a model where the baseline specification (2) is enriched with the variable *Sales* and with its interaction with the change in sovereign CDS spread $\Delta\log(CDS_{jt})$. Second, we look at firm-by-firm regressions and split the sample of firms into two groups ("Low domestic concentration" and "High domestic concentration"), based on whether the firm-average value of *Sales* is below or above 34.38%, which is the median value of firm-average *Sales*. We then average the coefficient estimates in each subsample, and test for differences in the sovereign-to-corporate spillover. The findings from the two analyses are presented in Table 5, and confirm our prediction: Firms whose sales are more heavily concentrated in the domestic market display a higher sensitivity to changes in sovereign risk than other companies.

[13] There may be concerns that firms previously classified as government controlled also predominantly cater to the domestic market (e.g., utilities). However, the correlation coefficient (at the firm–year level) of 0.284 between *Govt* and *Sales* suggests that this is not the case, and that the two channels are distinct.

5.3. Credit squeeze

Recent theoretical models (e.g., Gennaioli, Martin, and Rossi (2013)) argue that sovereign defaults lead to severe disruption in domestic credit markets. Such theoretical arguments find support in the empirical literature. Evidence by Borensztein and Panizza (2008) confirms that, indeed, sovereign defaults are frequently accompanied by domestic banking crises that further depress investment and output. In the context of the pre and post 2007–2009 crisis, Acharya, Drechsler, and Schnabl (2011) and Ejsing and Lemke (2011) document a significant increase in bank CDS spreads following an increase in sovereign CDS spreads. The transmission of sovereign to corporate credit risk (for financial and non-financial firms) goes as follows. First, the government provides a series of implicit and explicit guarantees to the financial system that become at risk as the sovereign creditworthiness deteriorates. Second, banks typically hold large amounts of government bonds in their portfolios that lose value as sovereign credit risk widens. As a result, banks' funding costs sharpen and fears of bank runs heighten. Third, the deleveraging of banks' balance sheets has an immediate impact on non-financial firms in terms of reduced bank lending. In this respect, Adrian, Colla, and Shin (2012) study the incremental financing choices of U.S. non-financial firms during the financial crisis of 2007–2009 and document a substitution from loan to bond borrowing together with a sudden increase in corporate financing costs. Hence, we expect the cost of funding for companies that rely more heavily on bank financing to be more severely affected by an increase in sovereign spreads.

We retrieve from Orbis the proportion of bank debt (*Bank*), computed as the ratio of bank loans to total debt (i.e., the sum of long-term debt plus long-term debt in current liabilities), which is our proxy for the firm's exposure to the banking sector. Overall, we have information on *Bank* for about 72% of sample firms.

To test the relevance of the credit squeeze channel, we replicate the methodological steps outlined in Sections 5.1 and 5.2 for the other transmission channels. First, we run a pooled

OLS regression where we add to specification (2) the variable *Bank* and its interaction with the change in sovereign CDS spread $\Delta\log(CDS_{jt})$. Second, we use firm-by-firm regressions and divide the sample of firms in two groups ("Low bank reliance" and "High bank reliance") based on whether their firm-average value of *Bank* falls below or above the median value of firm-average *Bank* (19.74%). Average coefficient estimates are then computed for each subsample, and tested for differences. Table 6 reports the results from both pooled OLS and firm-by-firm regressions: As expected, we observe that a loss in sovereign creditworthiness affects bank-dependent firms significantly more than other companies, thus confirming spillover from sovereign to corporate risk through the financial intermediation channel.

6. Additional results

In this section we provide a number of additional results. First, we show that the findings in Table 3 apply to most countries in the sample and are not driven by few Eurozone economies. Second, we address endogeneity concerns for the sovereign-to-corporate credit risk spillover by means of both an instrumental variable approach and an event study around firm-specific changes in creditworthiness. Finally, we investigate alternative explanations for the cross-sectional results documented so far: We reject that the government guarantees channel mask a more general access to government aid for firms deemed strategically important to a country, and we exclude that the credit squeeze channel proxies for debt rollover risk instead of operating primarily through bank deleveraging.

6.1. Country heterogeneity

One potential issue with the results in Table 3 is that the estimate of β may be specific to firms headquartered in a given country. To investigate cross-country heterogeneity in the response of corporate to sovereign credit risk changes, we re-estimate specification (2) by letting the coefficient on $\Delta\log(\text{Sov CDS}_{jt})$ be country-specific, and report results in Table 7-

Column (1). We document a positive and significant relation between changes in sovereign and corporate CDS spreads in all countries except Belgium. Estimates of β range from 0.137 for Germany to 0.312 for Spain and suggest that the sovereign-to-corporate spillover is overall stronger in peripheral than in core countries: The sensitivity to changes in sovereign risk is about two times larger in countries facing fiscal strain such as Italy, Portugal and Spain, than in virtuous economies such as France and Germany. The Wald test for equality of coefficients across countries rejects the hypothesis that the spillover effects are equal across the Eurozone countries (F-statistic of 3.314 with associated p-value of 0.003). We conclude that the positive and significant response of corporate to sovereign credit risk changes is not limited to few countries, but is instead general (albeit heterogeneous) across Eurozone economies.

6.2. Reverse causality

Our empirical specifications assume that the direction of causality goes from sovereign to corporate credit risk. Given that we only look at non-financial firms –which are less likely to be bailed out and less subject to contagion than banks– this assumption seems reasonable, since the potential default of a non-financial firm is unlikely to have an impact on sovereign credit risk.[14] However, one may still argue that government distress itself may be the result of corporate failure. To formally rule out reverse causality concerns, we conduct two analyses.

First, we re-estimate equation (2) by adopting an instrumental variables (IV) approach. We choose to instrument $\Delta\log(\text{SOV CDS}_{jt})$ with $\Delta\log(\text{SOV } \overline{\text{CDS}_{-jt}})$, i.e. log changes in the average sovereign CDS spreads of all Eurozone countries *excluding* country *j*. We argue that this is a strong instrument because variations in sovereign credit risk are highly correlated across Eurozone countries during the sample period. In the unreported first-stage regression,

[14] In the context of emerging markets, Dittmar and Yuan (2008) show that information flows from the sovereign to the corporate bond market.

we indeed find that $\Delta\log(\text{SOV } \overline{\text{CDS}_{-jt}})$ is significantly associated with $\Delta\log(\text{CDS}_{jt})$ after controlling for the full set of global and idiosyncratic factors. For the instrument to be valid, we also need variations in the credit quality of foreign countries to be uncorrelated with changes in the credit risk of domestic firms once the impact on domestic sovereign risk and other control variables has been taken into account. This may not be the case for firms whose features render them particularly sensitive to foreign sovereign risk, such as companies that predominantly export to foreign markets. However, as long as these attributes do not vary over time (at the firm level), this is unlikely to represent an issue in our analyses, given that we include firm fixed-effects in all specifications. Column (2) of Table 7 reports the estimates from the second-stage regression, and shows that (instrumented) changes in sovereign credit risk positively and significantly affect corporate credit risk.

Second, we exclude reverse causality by analyzing the reaction of both sovereign and corporate CDS spreads to rating changes in the non-financial firms in the sample. If, contrary to our conjecture, the spillover goes from corporate to sovereign credit risk, then corporate rating changes should affect both corporate and sovereign credit spreads. We gather data on rating changes for our sample firms from Bloomberg, which provides issuers' rating announcements (upgrades and downgrades) from Standard & Poor's, Fitch and Moody's. If a company experiences multiple rating changes within a 15-day period, we include the earliest rating change only. This leaves us with a sample of 196 downgrades and 70 upgrades for 87 unique firms. We follow an event study methodology and compute weekly CDS spreads as averages of daily CDS spreads before (day -5 to day -1) and after (day +1 to day +5) the rating change (day 0). Our variable of interest is the abnormal CDS change, which we measure with the difference between log weekly changes in CDS spreads around the event, and log weekly changes in a benchmark index. We use the iTraxx Europe index as the benchmark for corporate entities, and the average sovereign CDS spread of all Eurozone countries *excluding* country j ($\text{SOV } \overline{\text{CDS}_{-jt}}$) for sovereigns. Table 8 reports the cross-

sectional average of abnormal CDS changes, separately for upgrades and downgrades. We find that corporate rating changes significantly affect corporate credit spreads with the predicted sign, i.e. downgrades/upgrades produce a widening/tightening of corporate CDS spreads, respectively. Sovereign spreads are instead unaffected. This evidence further mitigates reverse causality concerns.

6.3. Access to government aid

One may argue that the government guarantee channel that affects firms under governmental influence could be masking a more general access to government aid, which is typically granted to those firms considered of strategic importance to a country. Strategic firms typically produce a large fraction of a country's economic output and employ a significant share of a country's workforce: As such, they are more likely to benefit from government aid in case of financial distress.[15] If sovereign risk increases, the value of such an "option" to access state aid for these strategic companies decreases and their creditworthiness might, in turn, be affected.

To test whether strategic firms are more exposed to sovereign risk than other firms, we measure the relevance of a firm with the ratio between the firm's market capitalization and the total market capitalization of the country (*MktCap*), both recorded on the closing date of the annual report.[16] The market capitalization of firms (in million of euros) and the closing dates of the annual reports are obtained from Orbis and the market capitalization of individual countries (in millions of euros) is obtained from Bloomberg. We then estimate the specification in (3) by replacing *Govt* with our proxy for strategic importance, *MktCap*, and

[15] The European Community Treaty generally prohibits state aid unless it is justified by reasons of general economic development. Recent examples of government aid include various measures adopted to support the automotive industry in the Eurozone.

[16] Alternative measures of the strategic importance of a firm may be based on firm size or the number of employees. However, such measures could overestimate a firm's contribution to the domestic economy when it operates internationally. Given that the proportions of domestic assets and of the workforce employed domestically are rarely available from the consolidated financial statements, we opt for market capitalization as a proxy for a firm's strategic relevance.

report the results in Column (3) of Table 7. As before, the impact of changes in sovereign risk on corporate risk is statistically and economically significant. However, we find no evidence that the credit spreads of strategic firms are significantly more affected than others by deterioration in the credit quality of the sovereign. Hence we argue that the spillover from sovereign to corporate credit risk is truly more relevant for companies under governmental influence than, generally, companies of strategic relevance to the country.

6.4. Refinancing risk

A potential objection to our findings on the credit squeeze channel is that we may be erroneously ascribing the effect to bank deleveraging while, in fact, it may be operating via debt rollover risk. To illustrate this point, suppose that a firm's financing needs can be met by (possibly a mix of) bank and other (e.g., bond) financing and that bank financing is short term while bond financing is long term. Under these circumstances, funding sources are directly related to corporate debt maturity, so that firms borrowing predominantly from banks are also characterized by shorter maturity debt and face higher refinancing risk than those tapping the bond market. If this were the case, the greater sensitivity to sovereign risk that we uncover for firms that rely on bank financing could be the byproduct of shorter debt maturities.[17] To test whether firms with shorter debt maturities are more exposed to changes in sovereign risk, we use the fraction of current to total debt as a proxy for refinancing risk (*Current*) and estimate specification (3) with *Current* in lieu of *Govt*. The regression results are reported in Column (4) of Table 7. As before, changes in corporate CDSs are significantly and positively associated with changes in sovereign CDSs. However, there is no evidence that firms with shorter debt maturities are more sensitive to variations in sovereign risk. We

[17] Greenwood (2002) documents that firms with a high current portion of debt display higher investment sensitivity to changes in interest rates when compared with firms with only long-term debt. Almeida et al. (2012) find that firms whose long-term debt was largely maturing right after the onset of the August 2007 credit crisis cut their investment more than otherwise similar firms whose debt was scheduled to mature after 2008.

conclude that the spillover from sovereign to corporate credit risk can be attributed to the refinancing risk of bank debt and not, more generally, of short-term debt.

7. Conclusions

We explore the effect of changes in the creditworthiness of a developed sovereign entity on the credit risk of non-financial firms headquartered in the same country. We measure credit risk with CDS spreads on both sovereigns and corporates from January 2008 to December 2011 for eight countries in the Eurozone. We report the following findings. First, an increase in sovereign risk translates into a significant increase in corporate credit risk, even after controlling for a set of firm- and time-specific variables. Second, the spillover effect is significantly higher for firms that enjoy government guarantees, place most of their output on the domestic market, or rely heavily on bank financing.

Our findings suggest that investors' concerns of a country's debt problems translate into higher funding costs for domestic non-financial corporate issuers. In this respect, strict fiscal discipline has both direct and indirect benefits for a country: It not only improves sovereign creditworthiness, but also reduces firms' borrowing costs, which, in turn, can foster economic growth. Additionally, loosening the links that exacerbate sovereign to corporate spillover effects should help stabilize corporate funding. The recent measures introduced by the Italian government to encourage the issuance of corporate bonds,[18] with the intended goal of reducing companies' reliance on bank financing, provide an example in this respect.

[18] See *The Wall Street Journal*, "Italy pushes bond issues to ease credit squeeze," January 23, 2013.

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Table A1. Control variables

This table provides a detailed description of the "Global" and "Idiosyncratic" control variables included in the model specification and their source.

Variable	Description	Source
	Global	
Market Return	Log return in the EuroStoxx 50 index	Bloomberg
Δ VStoxx	Change in the (annualized) implied volatility of the EuroStoxx 50	Bloomberg
Δ Equity premium	Change in the EuroStoxx 50 price earnings ratio	Bloomberg
Δ Treasury yield	Change in the yield of 5-year Eurozone government bonds whose issuers are rated AAA	ECB Statistical Data Warehouse
Δ Slope	Change in the slope of the yield curve, defined as the yield spread between 10- and 2-year Eurozone government bonds whose issuers are rated AAA	ECB Statistical Data Warehouse
Δ IG spread	Change in the yield spread between the FTSE Euro Corporate (excl. banks) BBB- and AA-rated European firms (divided by 100)	Datastream
Δ Exchange rate	Change in the EUR/USD exchange rate	Bloomberg
	Idiosyncratic	
Excess return$_i$	Firm's stock log return in excess of the log return in the domestic Dow Jones Total Market index	Bloomberg, Datastream
Δ Idiosyncratic vol$_i$	Change in the firm's (annualized) idiosyncratic volatility, computed as rolling standard deviation of the firm's excess stock returns over the past 180 days	Bloomberg, Datastream

Table 1. Summary statistics: Sample breakdown by country

This table shows summary statistics of the weekly CDS spreads of reference entities headquartered in Eurozone countries from January 2008 to December 2011. For each country, the table contains the number of firm-week observations, the number of firms, and the mean, median, and standard deviation of corporate as well as sovereign CDS spreads (bps). The last column reports the median long-term Standard and Poor's rating of firms in each country.

Country			*Corporate CDS*			*Sovereign CDS*			*Corp.*
	Obs.	*Firms*	*Mean*	*Median*	*Std.dev.*	*Mean*	*Median*	*Std.dev.*	*rating*
Belgium	773	5	115.1	85.0	74.5	94.2	88.8	63.3	A-
Finland	1,511	8	344.2	152.0	622.8	32.1	27.2	18.6	BBB
France	7,613	39	190.7	126.0	192.1	54.2	50.8	37.3	BBB+
Germany	5,864	31	230.1	121.4	375.1	34.2	32.4	18.1	BBB+
Italy	1,774	11	231.4	167.7	214.6	140.4	116.3	100.8	BBB+
Netherlands	1,838	10	88.7	77.6	49.2	45.0	38.6	27.8	A-
Portugal	790	4	243.9	186.0	196.8	306.4	136.6	337.3	BBB
Spain	1,675	10	190.4	147.0	146.6	138.1	114.4	89.5	A-
Overall	21,838	118	205.8	122.2	296.3	70.5	44.6	98.7	

Table 2. Principal component analyses

This table reports summary statistics for the principal component analyses of the correlation matrix of weekly changes in sovereign CDS spreads and the correlation matrix of weekly changes in corporate CDS spreads between January 2008 and December 2011. Panel A reports the percentage of variance explained by the first five components. Panel B reports the linear correlation coefficients between the first principal component and the global factors defined in Table A1. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	Sovereign		Corporate	
Principal Component	Sample Variation Explained (%)	Total	Sample Variation Explained (%)	Total
First	68.69	68.69	46.55	46.55
Second	13.36	82.05	4.26	50.80
Third	5.94	87.99	3.86	54.66
Fourth	3.34	91.33	3.16	57.82
Fifth	3.21	94.54	2.64	60.46

Panel B

	Sovereign	Corporate
Market return	-0.550***	-0.646***
Δ VStoxx	0.313***	0.434***
Δ Equity premium	-0.176**	-0.203***
Δ Treasury yield	-0.229***	-0.251***
Δ Slope	-0.042	-0.001
Δ IG spread	0.180***	0.409***
Δ Exchange rate	-0.430***	-0.285***

Table 3. Sovereign risk and corporate credit risk

This table shows the effect of changes in sovereign credit risk (Δlog(Sov CDS)) on corporate credit risk, both measured as weekly changes in the natural logarithm of CDS spreads. Columns (1) and (2) presents results from pooled OLS regressions including a set of control variables and firm fixed effects. Column (2) further includes the interactions of firm fixed effects with the control variables. Column (3) reports average parameter estimates and average adjusted R-squared (last row) from firm-by-firm OLS regressions. Definitions of the control variables are provided in Table A1. Standard errors in columns (1) and (2) are clustered at the firm level. Standard errors in column (3) are calculated from the cross-sectional variation of the parameter estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Δ log(Sov CDS)	0.174***	0.174***	0.177***
	(0.009)	(0.010)	(0.010)
Market return	-0.702***		-0.625***
	(0.033)		(0.033)
Δ VStoxx	0.091***		0.111***
	(0.018)		(0.018)
Δ Equity premium	0.057*		0.052
	(0.032)		(0.032)
Δ Treasury yield	-4.660***		-4.261***
	(0.489)		(0.511)
Δ Slope	-0.245		-0.092
	(0.787)		(0.756)
Δ IG spread	14.567***		14.493***
	(0.573)		(0.901)
Δ Exchange rate	0.479***		0.495***
	(0.046)		(0.058)
Excess return$_i$	-0.233***		-0.160***
	(0.028)		(0.026)
Δ Idiosyncratic vol$_i$	0.309***		0.526***
	(0.083)		(0.089)
Observations	21,838	21,838	21,819
Firms	118	118	115
Adj. R-squared	0.292	0.330	0.327

Table 4. Sovereign risk and corporate credit risk: Government guarantees

This table shows the effect of government guarantees on the spillover from sovereign risk to corporate credit risk. Column (1) includes the government control indicator (*Govt*, not shown), its interaction with changes in sovereign credit risk (Δlog(Sov CDS) x *Govt*), a set of control variables, firm fixed effects, and their interactions with the control variables. Columns (2) and (3) report average parameter estimates and average adjusted R-squared (last row) from firm-by-firm OLS regressions for the subsample of firms without (*Govt*=0) and with (*Govt*=1) government guarantees. Column (4) reports the t-test for difference in means between the two subsamples. Definitions of the control variables are provided in Table A1. Standard errors in column (1) are clustered at the firm level. Standard errors in columns (2) and (3) are calculated from the cross-sectional variation of the parameter estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
		No government guarantees	Government guarantees	t-test
Δ log(Sov CDS)	0.156***	0.155***	0.220***	2.631**
	(0.009)	(0.010)	(0.023)	
Δ log(Sov CDS) x $Govt_i$	0.059**			
	(0.024)			
Market return		-0.658***	-0.558***	1.578
		(0.043)	(0.046)	
Δ VStoxx		0.089***	0.153***	1.810*
		(0.023)	(0.027)	
Δ Equity premium		0.079**	-0.003	-1.190
		(0.039)	(0.056)	
Δ Treasury yield		-4.341***	-4.098***	0.211
		(0.591)	(0.990)	
Δ Slope		-0.325	0.381	0.425
		(0.899)	(1.399)	
Δ IG spread		14.570***	14.335***	-0.196
		(0.719)	(0.960)	
Δ Exchange rate		0.446***	0.596***	1.132
		(0.066)	(0.115)	
Excess $return_i$		-0.163***	-0.154***	0.168
		(0.034)	(0.042)	
Δ Idiosyncratic vol_i		0.482***	0.617***	0.736
		(0.111)	(0.146)	
Observations	21,838	14,490	7,329	
Firms	118	77	38	
Adj. R-squared	0.331	0.322	0.338	

Table 5. Sovereign risk and corporate credit risk: Domestic demand

This table shows the effect of the concentration of sales in the domestic market on the spillover from sovereign risk to corporate credit risk. Column (1) includes the proportion of domestic over total sales (*Sales*, not shown), its interaction with changes in sovereign credit risk (Δlog(Sov CDS) x *Sales*), a set of control variables, firm fixed effects, and their interactions with the control variables. Columns (2) and (3) report average parameter estimates and average adjusted R-squared (last row) from firm-by-firm OLS regressions for the subsample of firms with below median *Sales* (Low domestic concentration) and above median *Sales* (High domestic concentration). Column (4) reports the t-test for difference in means between the two subsamples. Definitions of the control variables are provided in Table A1. Standard errors in column (1) are clustered at the firm level. Standard errors in columns (2) and (3) are calculated from the cross-sectional variation of the parameter estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
		Low domestic concentration	High domestic concentration	t-test
Δ log(Sov CDS)	0.151***	0.157***	0.213***	2.185**
	(0.015)	(0.011)	(0.023)	
Δ log(Sov CDS) x $Sales_i$	0.066*			
	(0.038)			
Market return		-0.752***	-0.542***	2.938***
		(0.053)	(0.048)	
Δ VStoxx		0.076***	0.143***	1.558
		(0.029)	(0.031)	
Δ Equity premium		0.094**	0.039	-0.759
		(0.047)	(0.056)	
Δ Treasury yield		-4.474***	-3.605***	0.721
		(0.810)	(0.892)	
Δ Slope		-0.208	1.053	0.777
		(1.123)	(1.171)	
Δ IG spread		15.518***	13.855***	-1.231
		(1.088)	(0.801)	
Δ Exchange rate		0.454***	0.556***	0.952
		(0.068)	(0.082)	
$Excess\ return_i$		-0.246***	-0.074*	2.881***
		(0.043)	(0.042)	
Δ $Idiosyncratic\ vol_i$		0.329**	0.663***	1.807*
		(0.132)	(0.129)	
Observations	14,858	8,534	8,175	
Firms	89	44	43	
Adj. R-squared	0.334	0.354	0.309	

Table 6. Sovereign risk and corporate credit risk: Credit squeeze

This table shows the effect of reliance on bank loans on the spillover from sovereign risk to corporate credit risk. Column (1) includes the proportion of bank over total debt (*Bank*, not shown), its interaction with changes in sovereign credit risk (Δlog(Sov CDS) x *Bank*), a set of control variables, firm fixed effects, and their interactions with the control variables. Columns (2) and (3) report average parameter estimates and average adjusted R-squared (last row) from firm-by-firm OLS regressions for the subsample of firms with below median *Bank* (Low bank reliance) and above median *Bank* (High bank reliance). Column (4) reports the t-test for difference in means between the two subsamples. Definitions of the control variables are provided in Table A1. Standard errors in column (1) are clustered at the firm level. Standard errors in columns (2) and (3) are calculated from the cross-sectional variation of the parameter estimates. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
		Low bank reliance	High bank reliance	t-test
Δ log(Sov CDS)	0.153***	0.147***	0.226***	3.071***
	(0.012)	(0.01)	(0.023)	
Δ log(Sov CDS) x $Bank_i$	0.081**			
	(0.039)			
Market return		-0.738***	-0.554***	2.295**
		(0.058)	(0.055)	
Δ VStoxx		0.094***	0.112***	0.410
		(0.027)	(0.036)	
Δ Equity premium		0.108**	0.068	-0.529
		(0.050)	(0.055)	
Δ Treasury yield		-4.651***	-3.697***	0.792
		(0.778)	(0.919)	
Δ Slope		0.133	0.121	-0.006
		(1.254)	(1.317)	
Δ IG spread		15.302***	14.300***	-0.744
		(0.904)	(0.998)	
Δ Exchange rate		0.520***	0.478***	-0.368
		(0.073)	(0.089)	
$Excess\ return_i$		-0.200***	-0.151***	0.799
		(0.037)	(0.050)	
Δ $Idiosyncratic\ vol_i$		0.233**	0.794***	3.070***
		(0.110)	(0.146)	
Observations	15,151	8,100	7,834	
Firms	85	42	41	
Adj. R-squared	0.334	0.337	0.316	

Table 7. Sovereign risk and corporate credit risk: Additional results

This table reports parameter estimates of the impact of sovereign risk on corporate credit risk, controlling for global and firm-level factors. All specifications include a set of control variables, firm fixed effects, and their interactions with the control variables. Definitions of the control variables are provided in Table A1. Column (1) reports results for specification (2) allowing the coefficient of changes in sovereign credit risk ($\Delta\log(\text{Sov CDS}_{jt})$) to be country-specific. Column (2) reports second-stage regression results for specification (2) where changes in country j sovereign credit risk ($\Delta\log(\text{Sov CDS}_{jt})$) are instrumented with changes in average sovereign credit risk of all other European countries ($\Delta\log(\text{SOV } \overline{\text{CDS}_{-jt}})$). The other columns test the effects of a firm's: (1) strategic relevance for a country; (2) short term refinancing needs, on the spillover from sovereign risk to corporate credit risk. Column (3) includes the measure of firm's strategic relevance – i.e. the ratio between the firm's market capitalization and the total market capitalization of the country – (*MktCap*, not shown), and its interaction with changes in sovereign credit risk ($\Delta\log(\text{Sov CDS})$ x *MktCap*). Column (4) includes the measure of firm's short term refinancing needs – i.e. the fraction of current debt to total debt – (*Current*, not shown), and its interaction with changes in sovereign credit risk ($\Delta\log(\text{Sov CDS})$ x *Current*). Standard errors are clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Belgium	0.085			
	(0.053)			
Finland	0.155***			
	(0.020)			
France	0.164***			
	(0.012)			
Germany	0.137***			
	(0.011)			
Italy	0.276***			
	(0.050)			
Netherlands	0.188***			
	(0.018)			
Portugal	0.262**			
	(0.109)			
Spain	0.312***			
	(0.053)			
Δ log(Sov CDS)		0.249***	0.160***	0.181***
		(0.011)	(0.011)	(0.014)
Δ log(Sov CDS) x MktCap_i			0.454	
			(0.294)	
Δ log(Sov CDS) x Current_i				-0.047
				(0.061)
Observations	21,838	21,838	19,200	19,385
Firms	118	118	102	103
Adj. R-squared	0.334	0.338	0.336	0.334

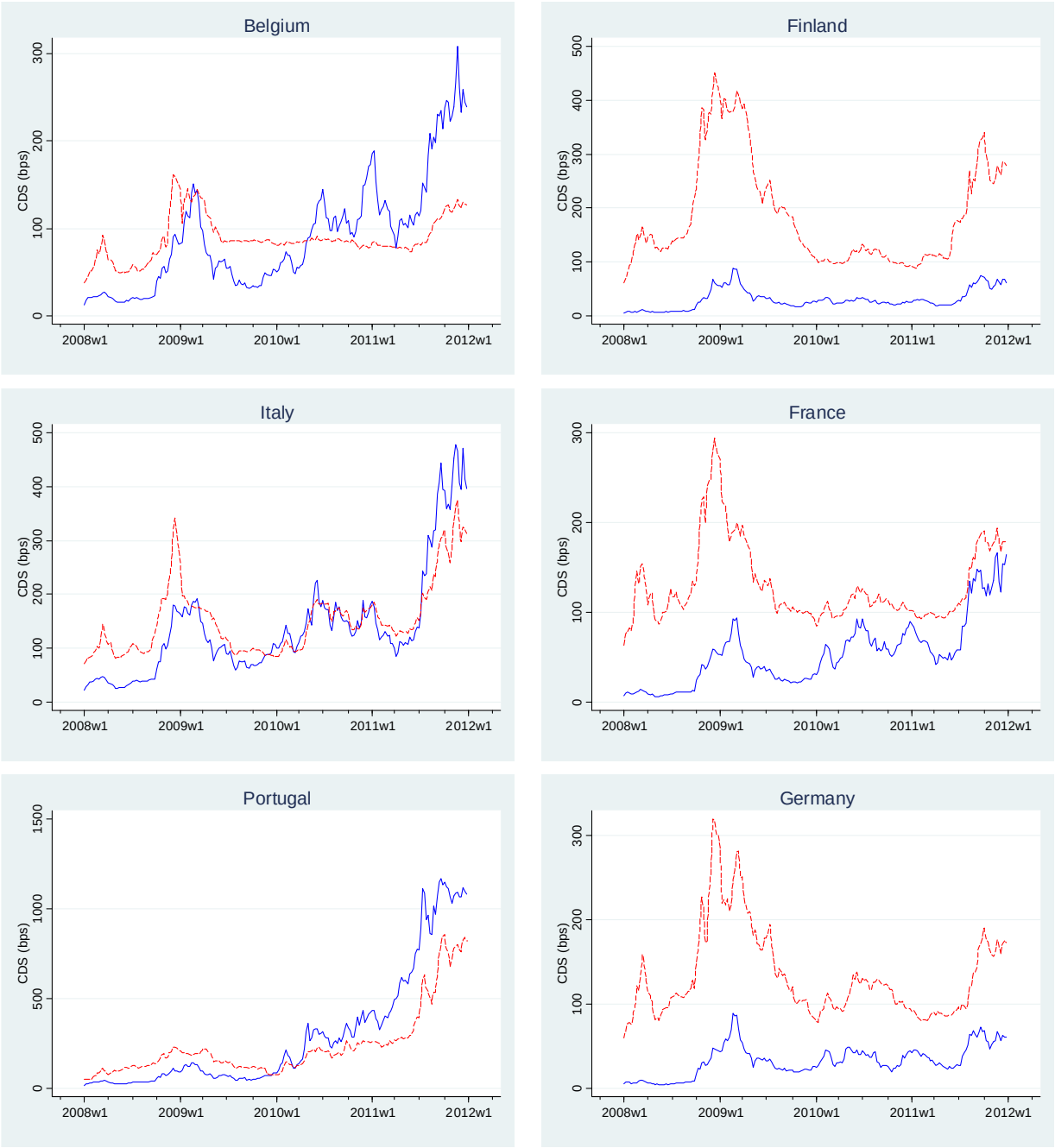
Table 8. Corporate rating changes: Impact on corporate and sovereign CDSs

This table reports the effect of corporate rating changes on corporate and sovereign credit spreads. Corporate rating changes include 196 downgrades and 70 upgrades from Standard & Poor's, Moody's and Fitch. Abnormal corporate CDSs are differences between log weekly corporate CDS changes and log weekly Itraxx changes around the rating action. Abnormal sovereign CDSs are differences between log weekly sovereign CDS changes and log weekly changes in average sovereign CDS spreads of all other European countries around the rating action. T-statistics are given in parenthesis below average abnormal CDSs. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Rating upgrades		Rating downgrades	
	Abnormal corporate CDSs	Abnormal sovereign CDSs	Abnormal corporate CDSs	Abnormal sovereign CDSs
Mean	-0.028***	-0.002	0.020***	0.001
t-stat	(-3.999)	(-0.306)	(2.627)	(0.137)

Figure 1. Sovereign and corporate credit risk

The solid line represents the sovereign CDS spread and the dashed line the median CDS spread computed across non-financial reference entities headquartered in a country.



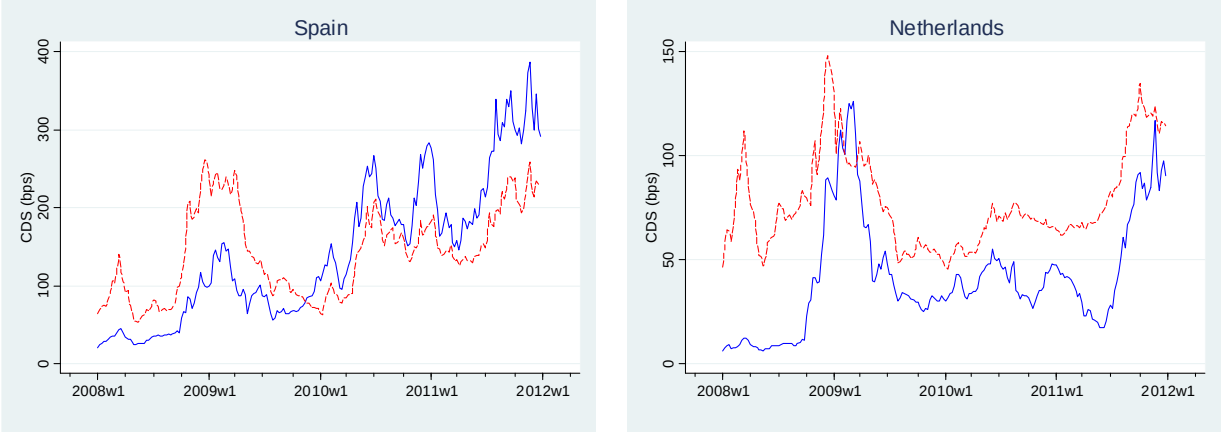


Figure 2. Principal component analysis: Loadings of first principal component

The left panel shows loadings of the first principal component from the PCA on sovereign CDS spread changes. The right panel is a histogram of loadings of the first principal component from the PCA on corporate CDS spread changes.

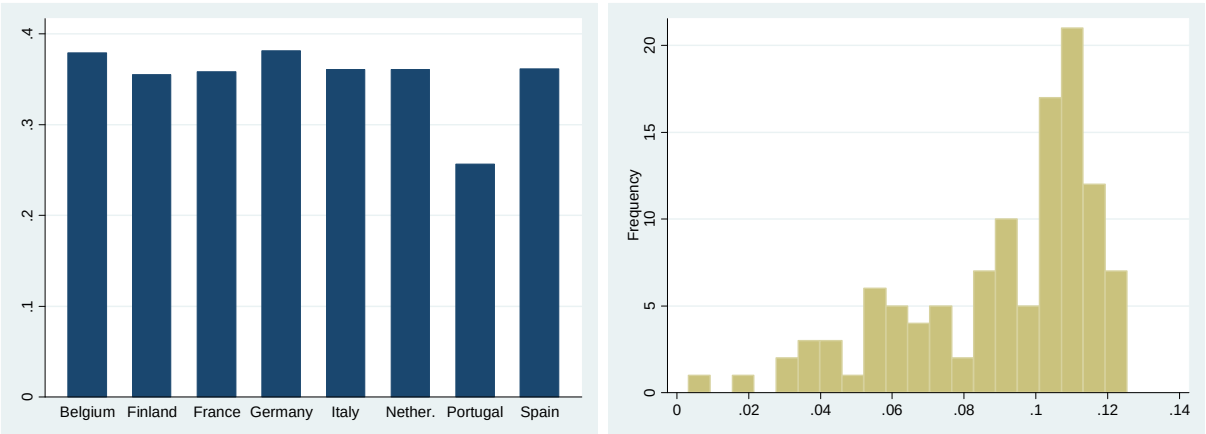


Figure 3. Correlation between sovereign and corporate credit risk

Rolling correlation, computed over 52 weeks, between median log weekly changes in corporate CDS spreads and log weekly changes in sovereign CDS (solid line) with 90% confidence intervals (shaded area).

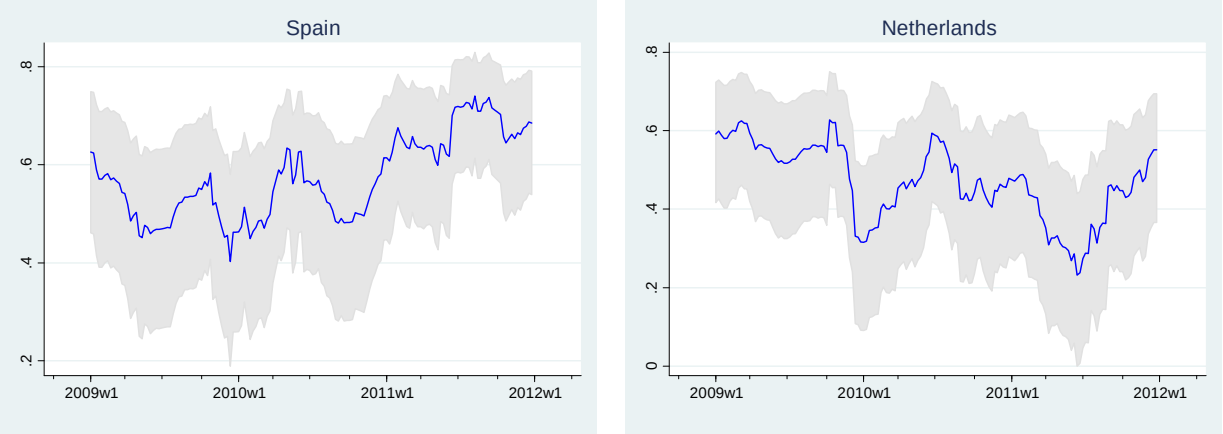


Figure 4. Sovereign and corporate credit risk: cross-firm heterogeneity

Firm-specific estimates of β from specification (1) using firm-by-firm regression (solid line) together with 90% confidence intervals, based on robust standard errors corrected for heteroscedasticity (shaded area).